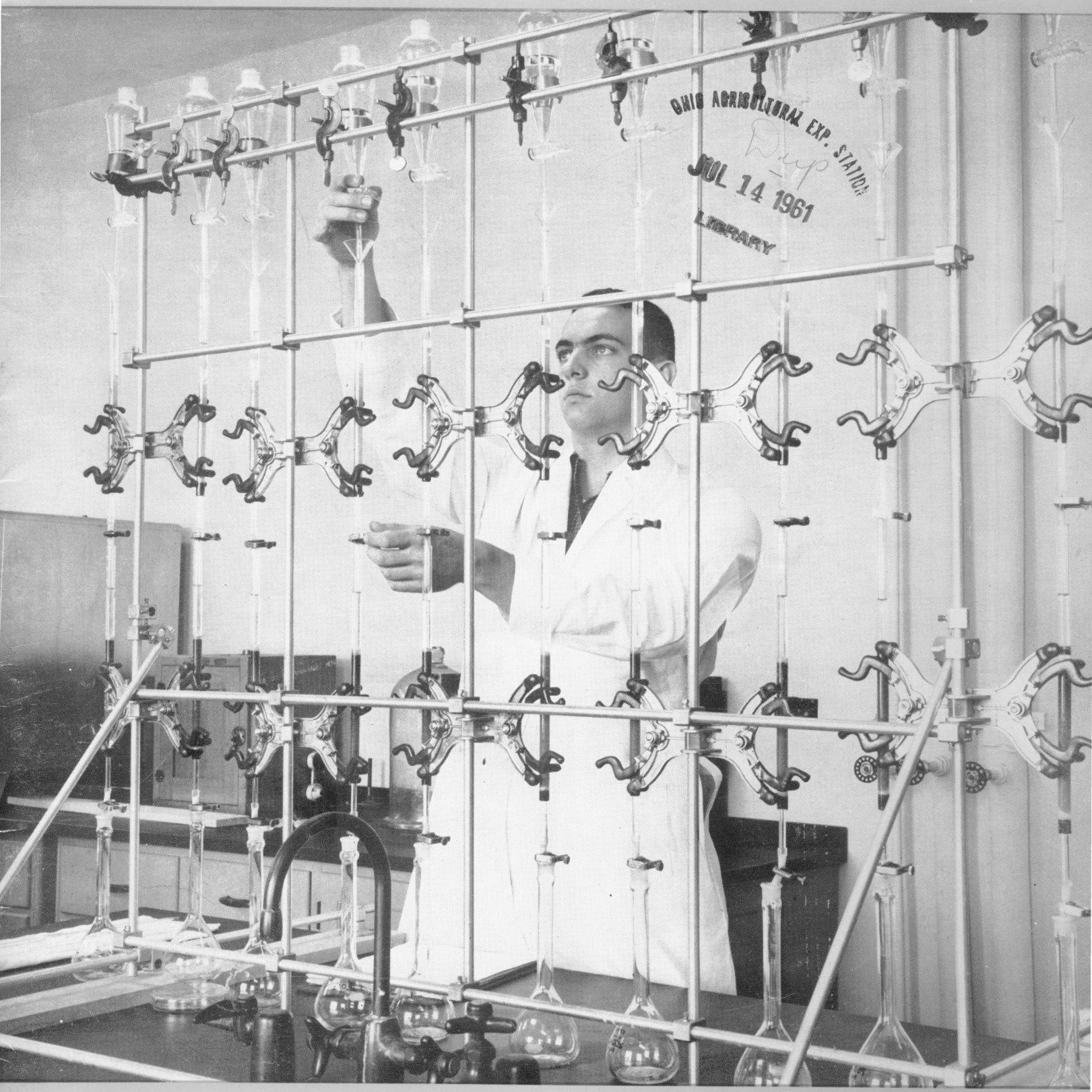
seventy-ninth ANNUAL REPORT

Bulletin 875

January 1961

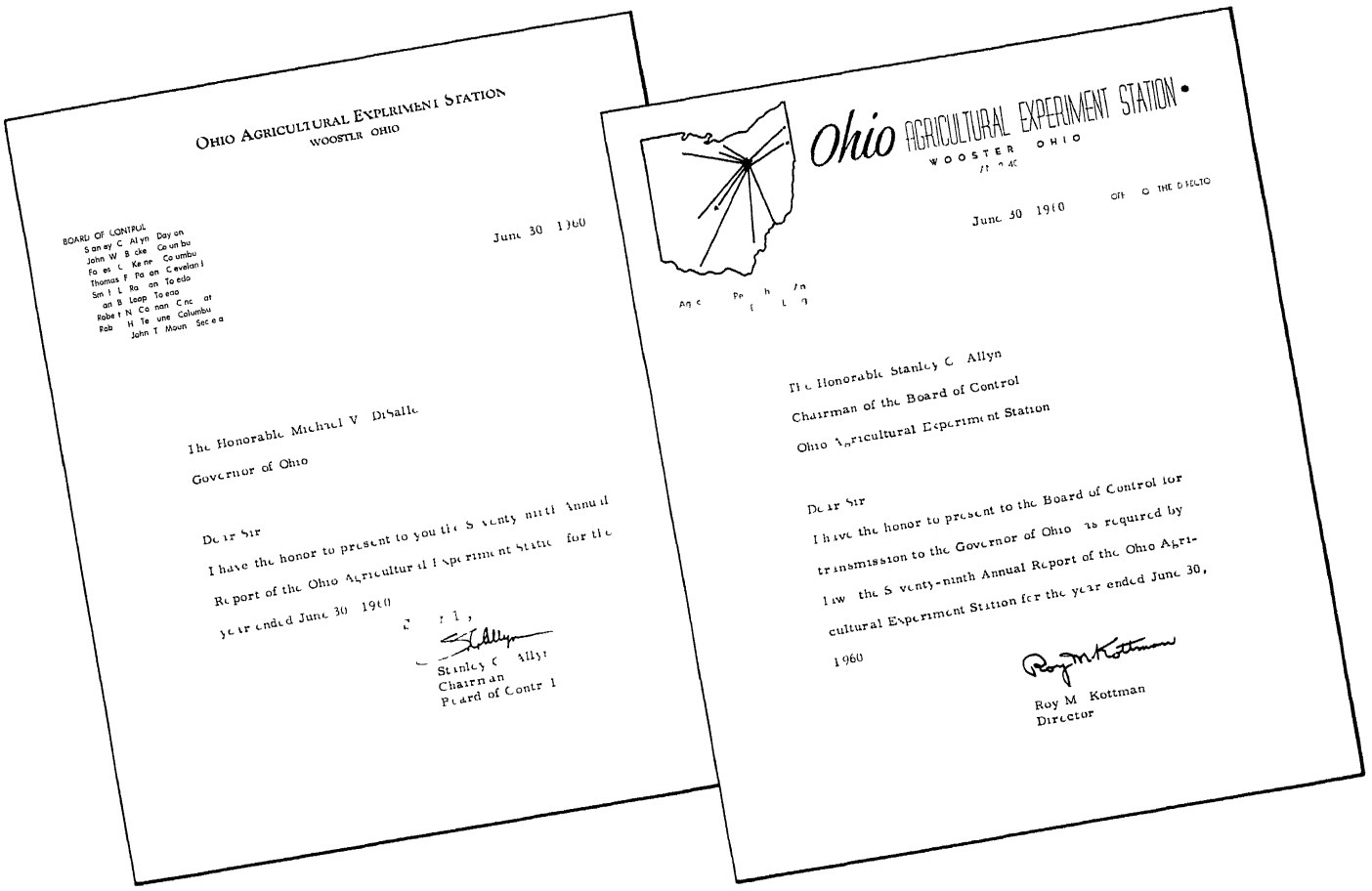


OHIO AGRICULTURAL EXPERIMENT STATION
Wooster, Ohio

Table of Contents

On the Cover . . .

This young scientist is working in one of the Horticulture Department laboratories. The apparatus he has set up is used in research on sugar sands from maple syrup.



OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER OHIO

June 30 1960

The Honorable Michael V DiSalle
Governor of Ohio

Dear Sir
I have the honor to present to you the Seventy ninth Annual Report of the Ohio Agricultural Experiment Station for the year ended June 30 1960

Stanley C Allyn
Chairman
Board of Control

Ohio AGRICULTURAL EXPERIMENT STATION
WOOSTER OHIO

June 30 1960

The Honorable Stanley C Allyn
Chairman of the Board of Control
Ohio Agricultural Experiment Station

Dear Sir
I have the honor to present to the Board of Control for transmission to the Governor of Ohio as required by law the Seventy-ninth Annual Report of the Ohio Agricultural Experiment Station for the year ended June 30, 1960

Roy M Kottman
Director

Dedication . . .

This Annual Report is dedicated to Dr. L. L. Rummell who served as Director of the Ohio Agricultural Experiment Station from January 1, 1947 through December 31, 1959. Director Emeritus Rummell eloquently expresses in the Foreword to this report a philosophy of service to all citizens which developed under his administration and might well be emulated and extended.

It is with a deep sense of humility that those who are to carry forward the program of a great research institution dedicate themselves to meet the great challenges that lie ahead.

Roy M. Kottman
Director

W E Krauss
Associate Director

Leadership During 1959 - 1960

L. L. RUMMELL
Director, July 1–Dec. 31

W. E. KRAUSS
Acting Director, Jan. 1–May 30

R. M. KOTTMAN
Director, June 1–June 30

During the year the administration of the Experiment Station was in the hands of the above three directors L. L. Rummell retired as of December 31, 1959, following 12 years at the helm. During the interim between his retirement and appointment of a successor, W. E. Krauss, Associate Director under Rummell, served as Acting Director. Roy M. Kottman served as administrative consultant, starting January 1, until his appointment as Director on June 1

FOREWORD

Nostalgic reminiscences are usually trite and boring. My farewell report (covering the first half of the fiscal year to January 1, 1960) will have the essence of brevity.

After 12 years as director we pass the reins on to younger hands, who will guide a team of distinction among the land grant colleges.

In this short span the Ohio Agricultural Experiment Station expanded tremendously in research, in personnel, in salary stature, in communications, in new services, in its public relations, including acceptance by citizens everywhere.

An understanding legislature, a mirror of public opinion, gave more funds for expansion in this short period than in a previous half-century.

Agricultural research assumed a new importance nationally as well as in the state. City cousins realize more that there is a heritage in the soil that must be preserved, that national strength lies in soil resources, that they (citizens of the city) enjoy three square meals daily because of improved agricultural technology and mechanization, and that a greater income to the farm family is basic to a solution of the "farm problem."

Farm organizations have rallied to the support of agricultural education and research in greatest measure in history. The cooperative movement among farmers has grown.

To serve the interests of all farmers better the Experiment

Station in recent years disposed of several farms, added four larger farms toward a compact pattern of intensive "supermarket" type experiment station, each designed to serve directly the farm interests of its area of the state.

The Experiment Station is answerable to requests of growers, breeders, feeders, consumers, for the latest news on research. With cooperation of the Extension Service a broadened information service now blankets the state.

Home economics assumed greater stature in research. Enlarged services came especially in dairy technology, veterinary science, poultry science, agricultural engineering, and agricultural economics and rural sociology.

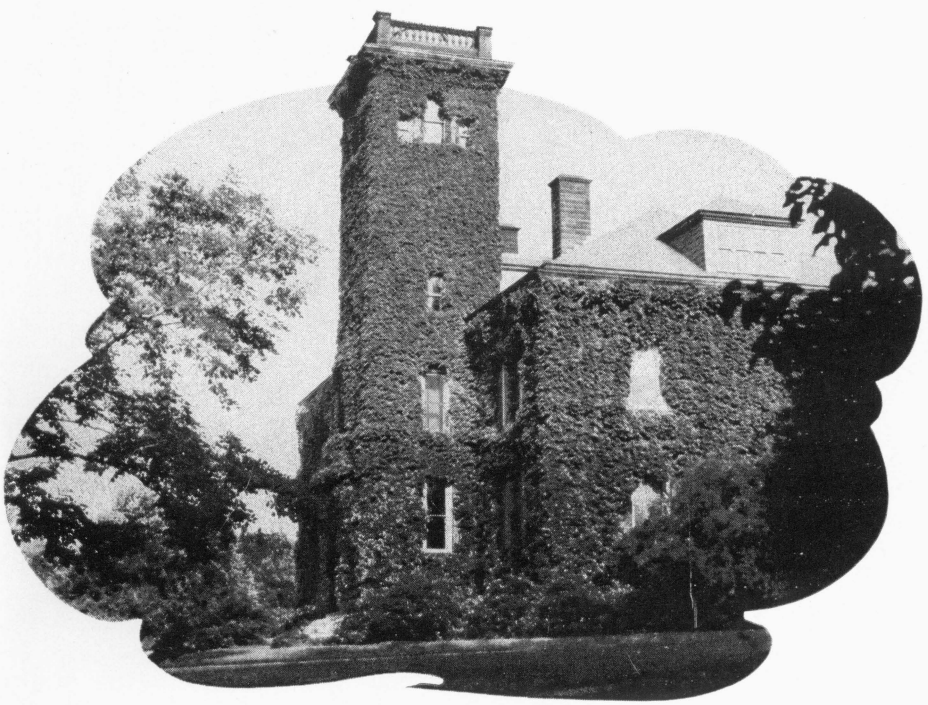
It is only human to assume some pride in association with a team of dedicated scientists and educators who made possible such progress in this short span of Experiment Station history. It is possible to see as much growth ahead on such a firm foundation.

S. S. Rummell

Director Emeritus

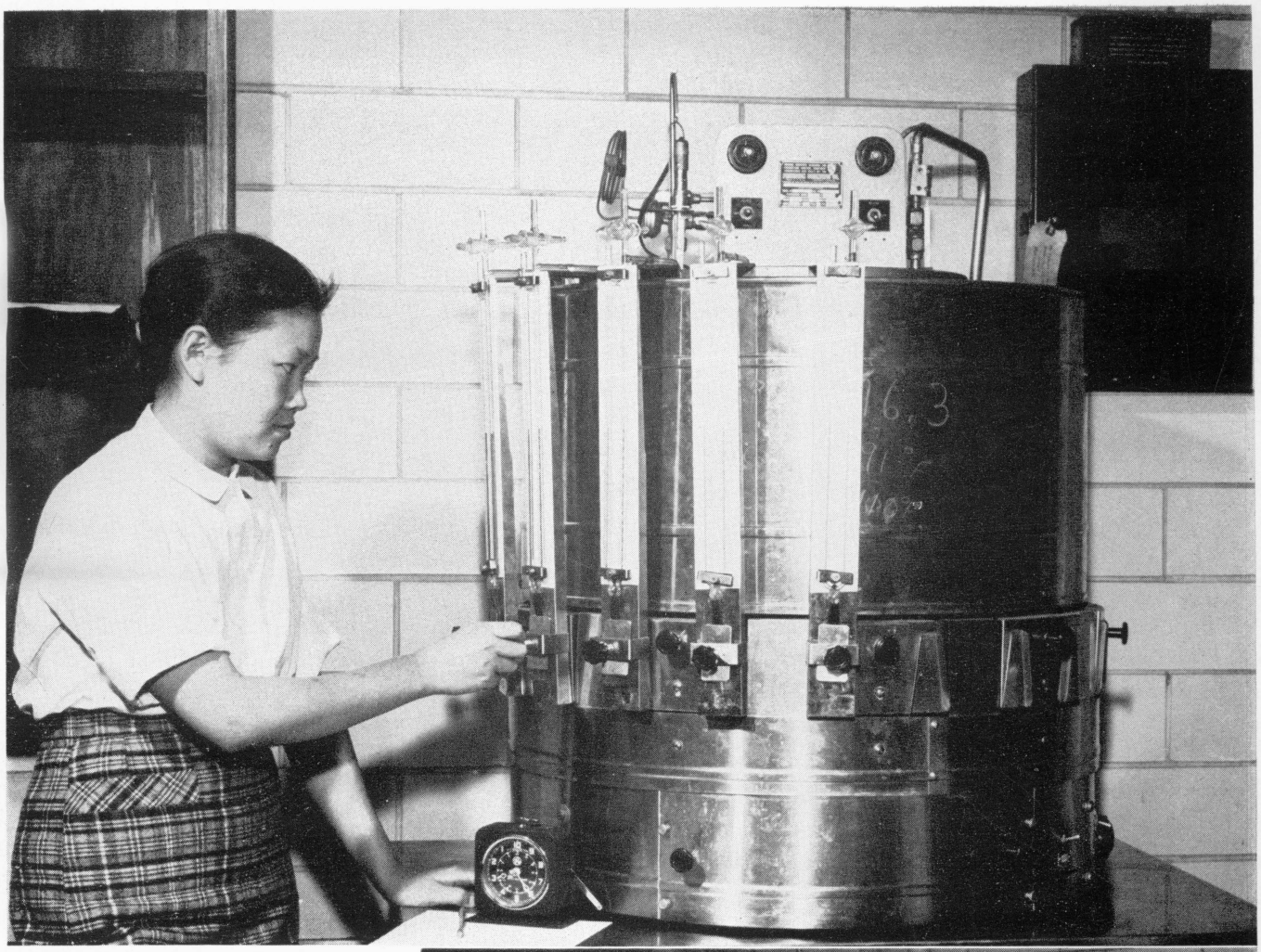
There was also continued physical growth of the Station. A new Agricultural Engineering Building was dedicated in October, 1959. This added much expanded facilities for research in that field to the Wooster campus. Previously, the group had been stationed in Columbus. Also joining the engineering research staff were several USDA personnel formerly stationed at Toledo.

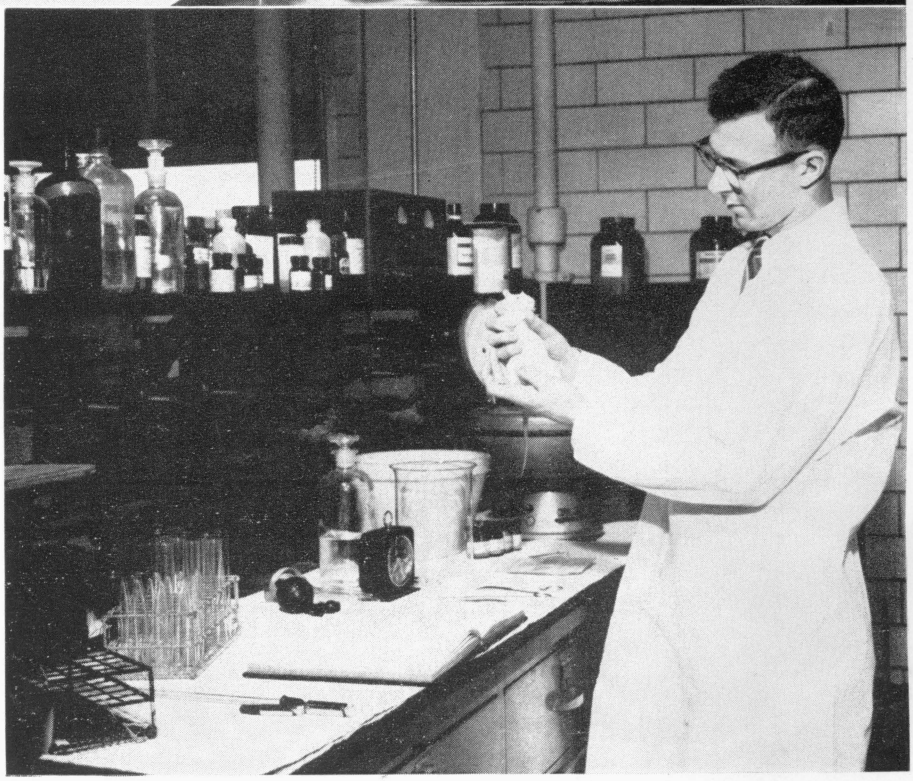
Appropriations from the Legislature provided funds for the erection of a new greenhouse and headhouse for the Horticulture Department. Also included were funds for the erection of a feed storage and processing unit that will aid in the nutrition work with livestock. Another major addition will be the construction of an isolation building for the Veterinary Science Department.



Research on DISPLAY

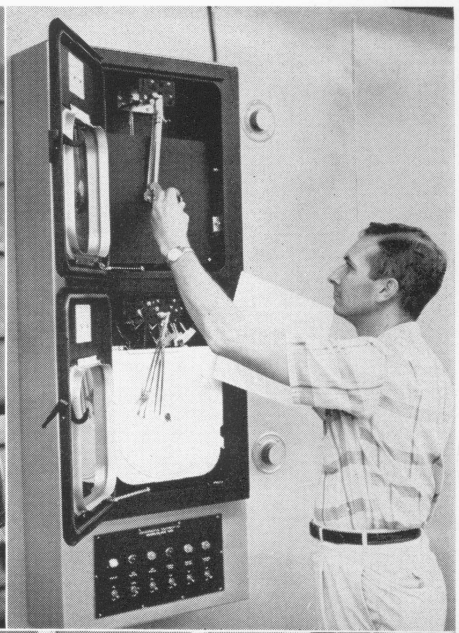
The next 14 pages of this annual report present an abbreviated review of the research being done in the Station departments. It is hoped that this brief presentation will make Ohioans better acquainted with the breadth and depth of their Experiment Station's research program.



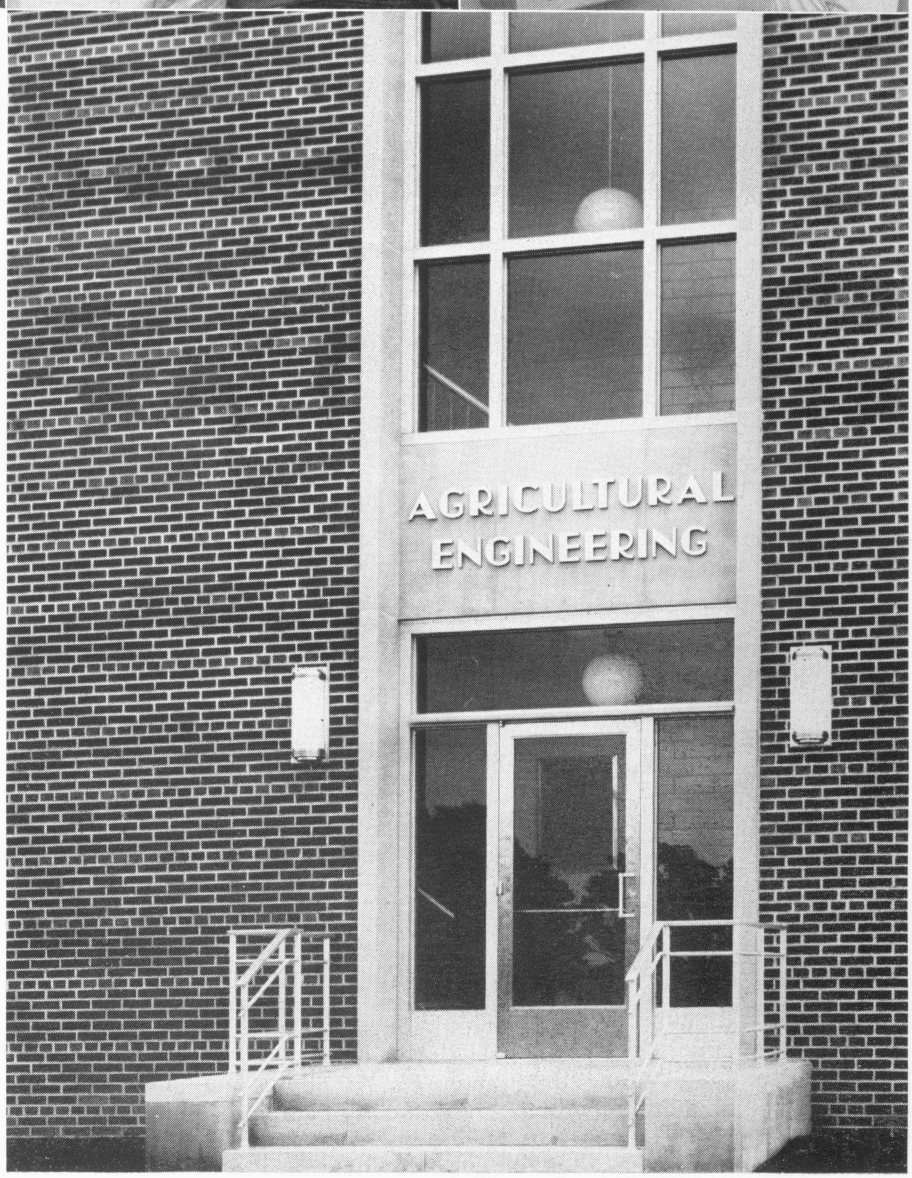


AGRICULTURAL BIOCHEMISTRY . . . Basically, this department is concerned with the chemical processes in biological systems—microorganisms, plants and animals. Numerous projects are underway including such things as the biochemical nature of quality in meat. In the photograph above, a student is checking the respiration of tissue in her research on the biochemical processes responsible for the germination of peas. In the laboratory at right another student is examining a rat which is being used to study how proteins are synthesized.

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY . . . Probably no other department studies as many different phases of agricultural activity. Projects will range from costs of handling hay for feeding livestock to the marketing of farm products. The photograph directly below was used in a survey of how Ohio farmers have adopted irrigation in their operations. The mother and child at the right are showing how the new home milk dispensers fit into the family economy. In the photograph at the bottom of page, some of the staff members of the department are studying crop production costs, one of the projects now in force.



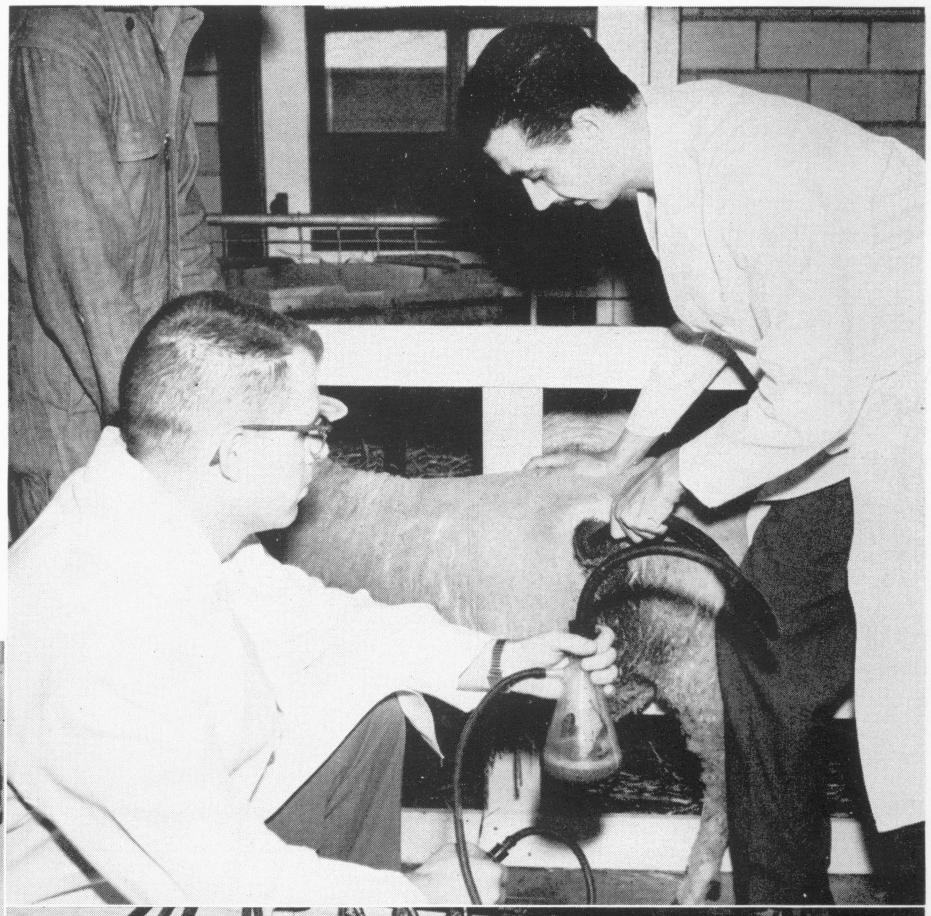
AGRICULTURAL ENGINEERING . . During the year covered by this report, agricultural engineering research facilities were made available on the Wooster campus for the first time. The top left picture shows a step in determining the moisture content of grain. In the center an adjustment on one of the test pieces of farm equipment is being made. At right a setting in the constant temperature laboratory is being accomplished. At right below, is the entrance of the newest departmental building on the campus. Among its facilities is a large equipment workshop where some of the largest pieces of equipment can be brought in for research purposes.

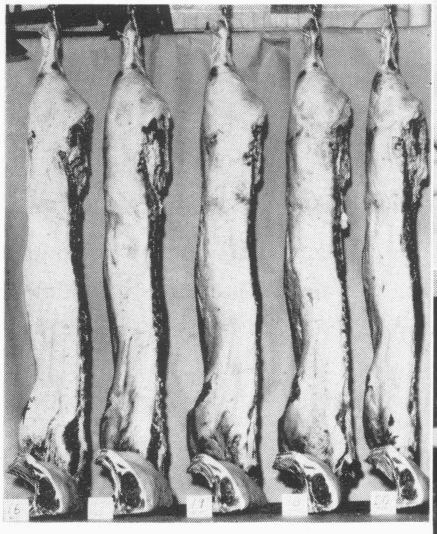


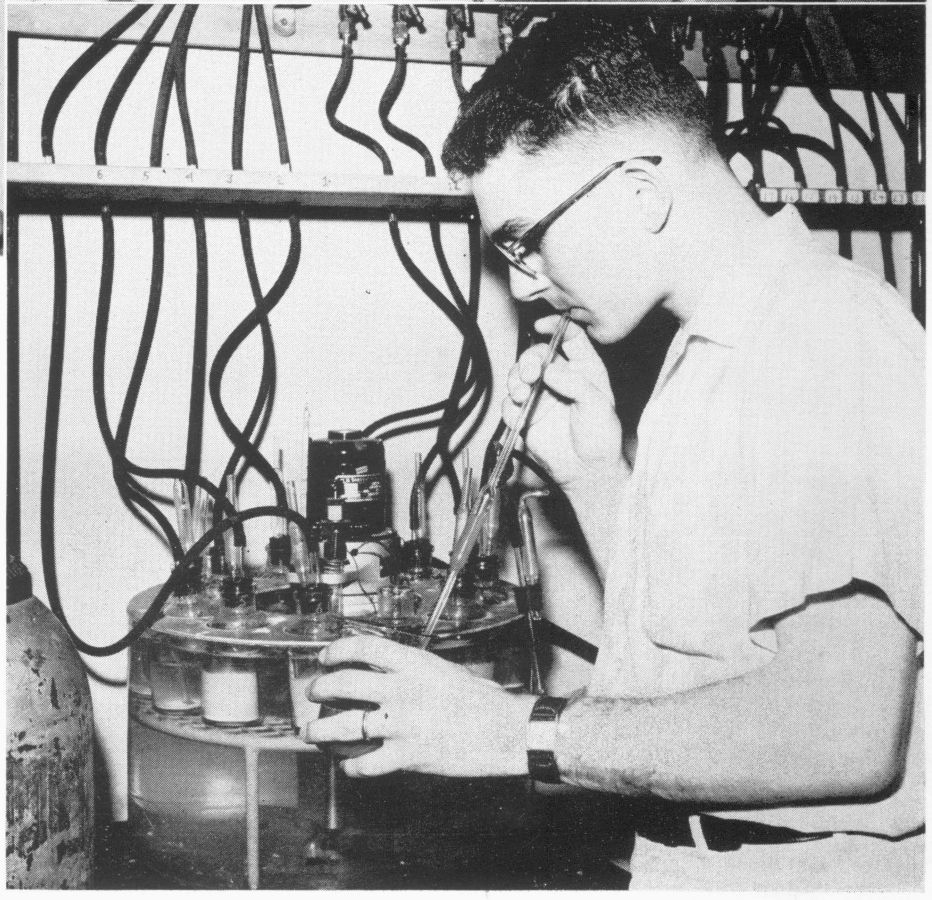
AGRONOMY . . . One of the most basic of the Station's research departments, Agronomy, has contributed many advancements to Ohio agriculture through the years. Improved grain varieties, better forage crops, and more effective use of fertilizers have resulted from research in this area. At the top, left, a Station agronomist is checking a plot in a pasture project. At right, corn is being checked for bird-resistant qualities as a step in combating bird damage. At left, a scientist uses the latest in electronic equipment to determine deficiencies in soybeans.

ANIMAL SCIENCE . . . The name of this department describes the nature of its work. Through research to improve the breeding, reproduction, carcass quality and nutrition of livestock, producers are able to supply better and more desirable meat and wool at lower costs.

Rumen studies are important in determining how animals assimilate various foods. In the photograph at the right one phase of rumen work is displayed. Rumen juice is being drawn from a fistulated animal to study the bacterial action on food in the process of digestion through use of the artificial rumen.





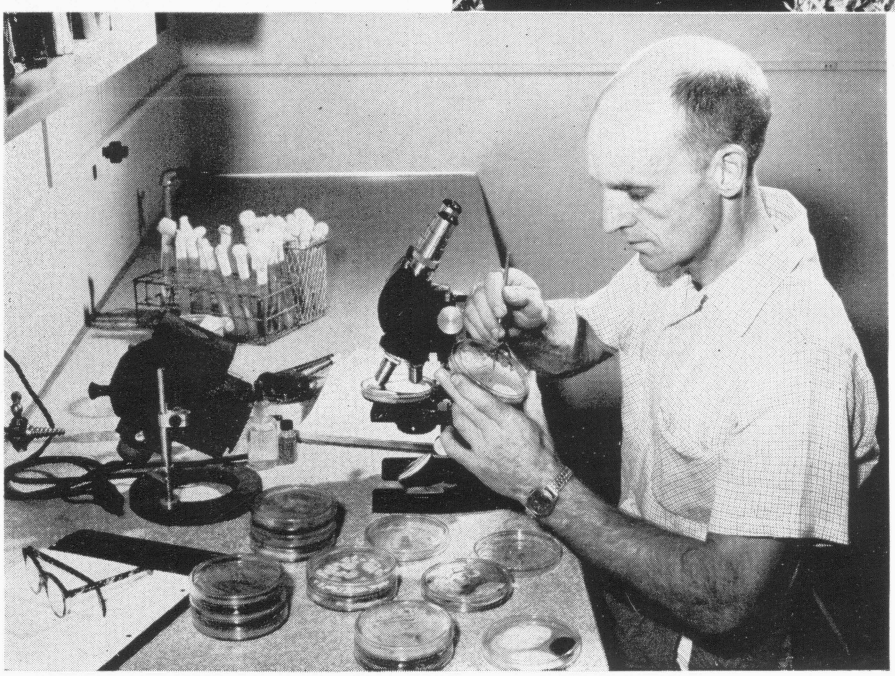


Ohio was one of the first to develop and use an artificial rumen which simulates the conditions in a cow's rumen in respect to temperature, gases and other factors. The rumen fluid in the pipette was taken from a steer with a "window in its side". This research helps develop understanding of animal function and results in better feeding regimes for livestock.

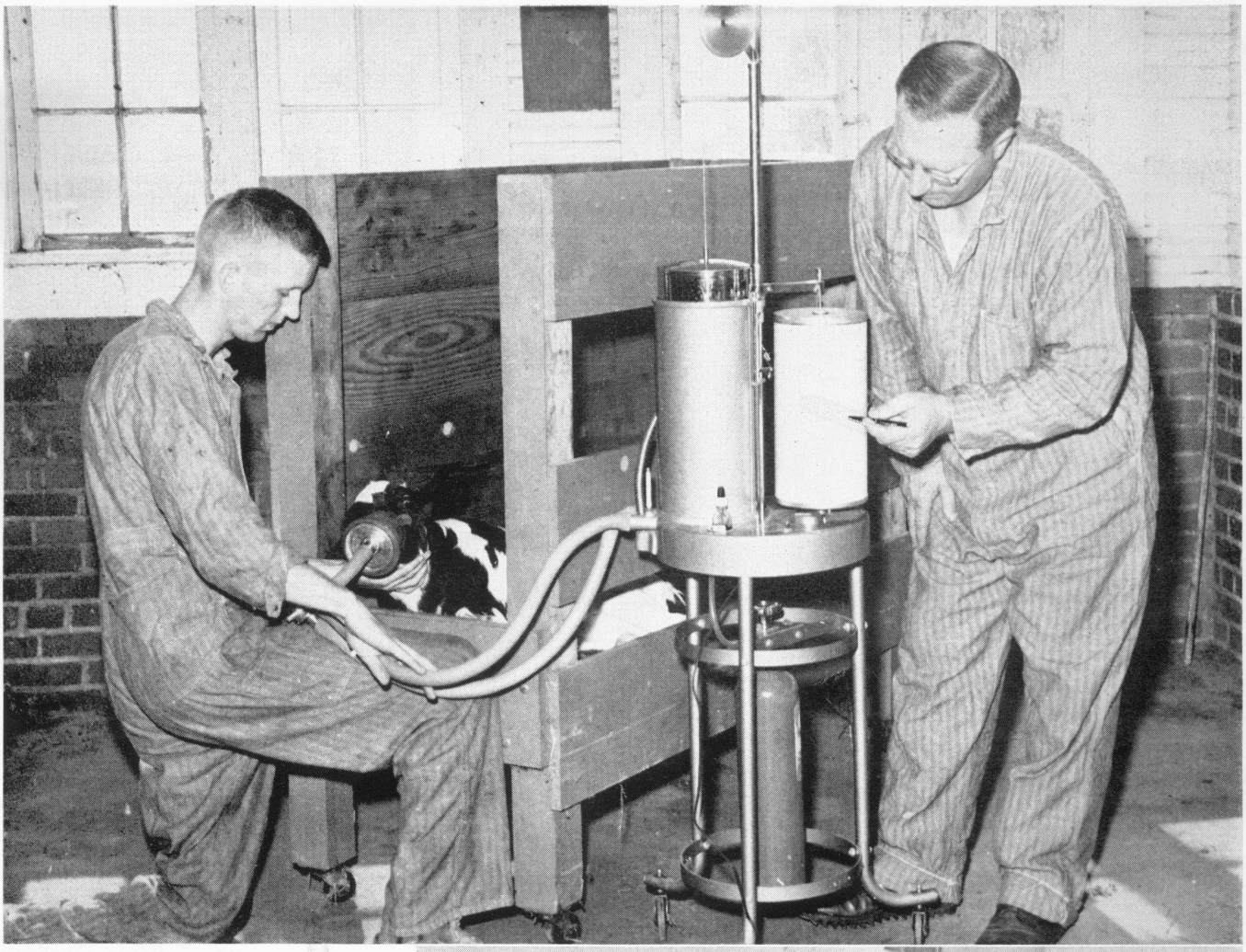
In the small illustration above, carcasses of bulls and steers are compared to show results of sex hormones and the ratio of fat to lean meat. Research attempts to produce the type animal consumers prefer.

BOTANY AND PLANT PATHOLOGY . . . Efforts of the members of this department do much to curb the diseases that cut agricultural production in Ohio. Their work ranges through many phases of disease investigation and control. Fruit and cereal grain diseases, development of resistant varieties, and root rot investigations are only a few of the many projects of this group.

In the photograph at right, workers are checking for oak wilt disease. When this disease made its way into the state a number of years ago, Station pathologists and entomologists began an active investigation of causes of the disease and possible methods of transmission.

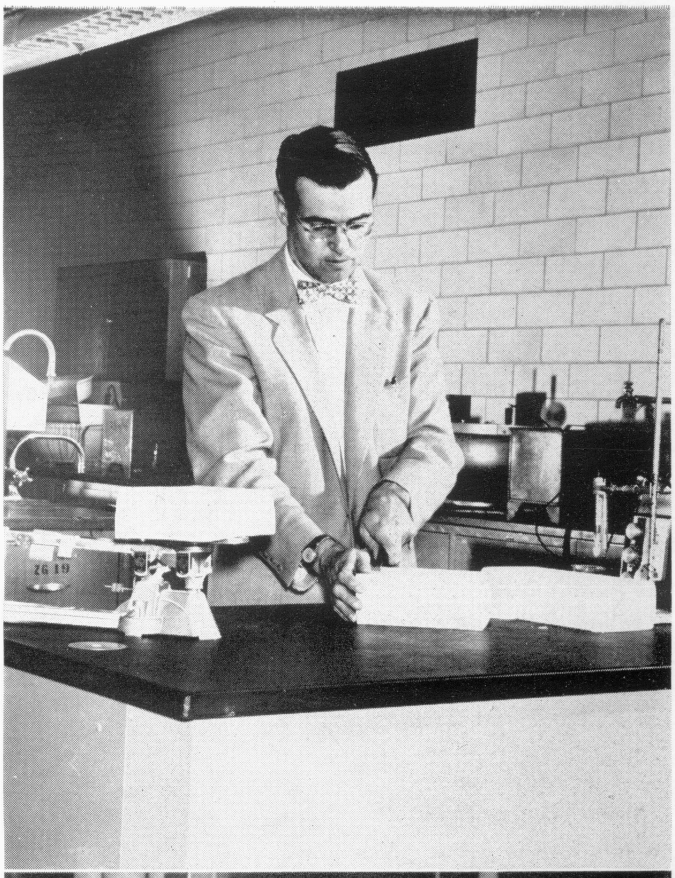


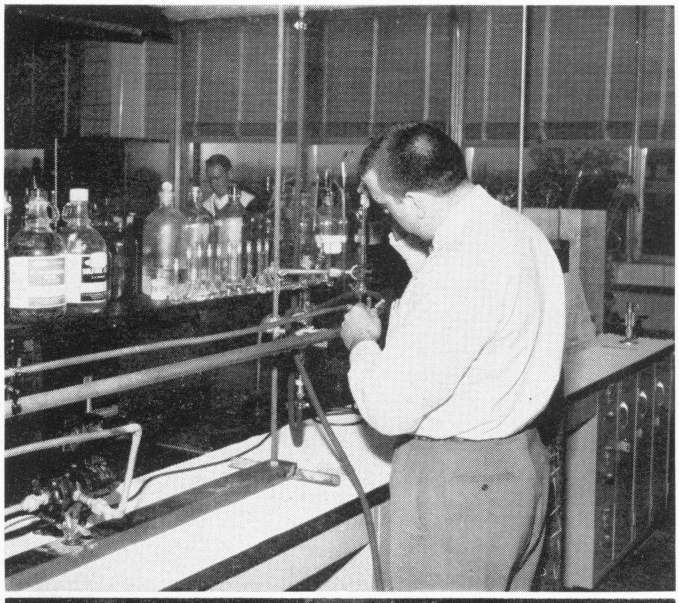
In the illustration at the left a scientist is checking soil fungi from various locations. From such studies have come recommendations that crop rotations can help defend crops against disease. Recent work in this field has shown that wheat seedling blight was not as severe when oats or soybeans preceded the wheat as when the grain was sown in successive years.

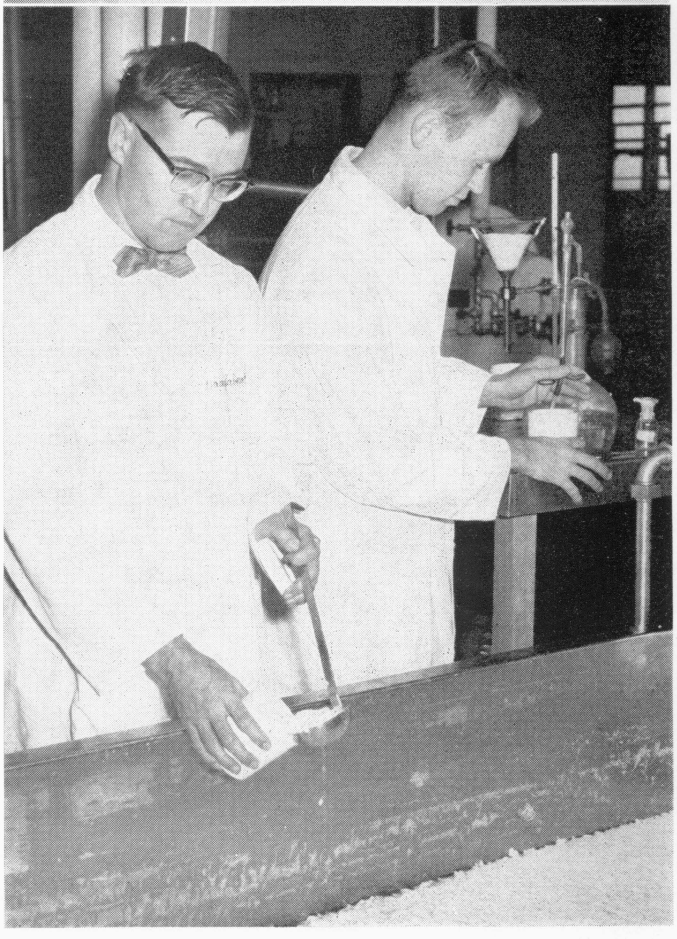


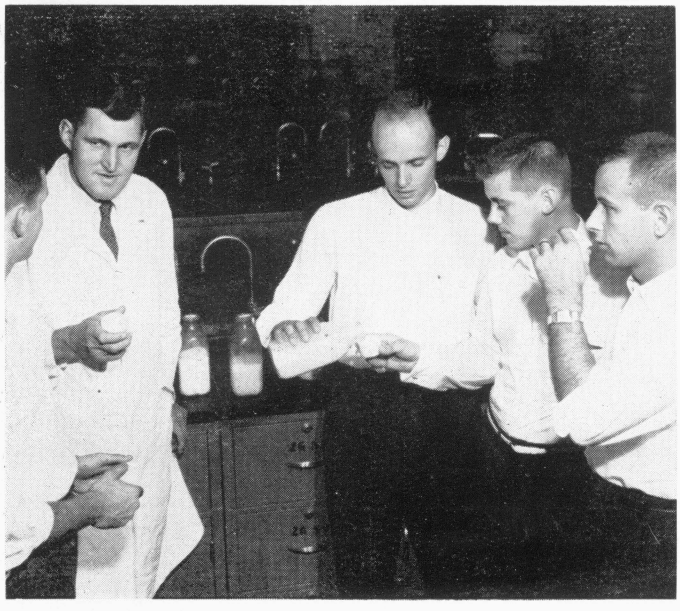
DAIRY SCIENCE . . . Ohio ranks high in the production of dairy products and this is not forgotten in the research planned by our dairy scientists. In the photograph at the top a Benedict-Roth respirometer is used to determine the oxygen consumption of the young calf. From this information, researchers will be able to calculate the changes in energy required by calves. The cow in the illustration below consumed 350 pounds per day of an alfalfa-brome mixture in a silage and soilage feeding test.

DAIRY TECHNOLOGY . . . Improving dairy products is the purpose and constant goal of this department. One of the current projects is concerned with the factors responsible for the development of full-flavored cheddar cheese . . . another is a study of the flavor of market milk and the relationship to variations of the organic constituents. In the photograph at the right, a staff member is weighing and checking some of the cheese manufactured in the department. Immediately below that is a step in the manufacture of the cheese with a routine check being made to determine how the process is moving along. Below at left, is illustrated isolation of flavor compounds from milk, and below that the actual tasting of milk in the laboratory.









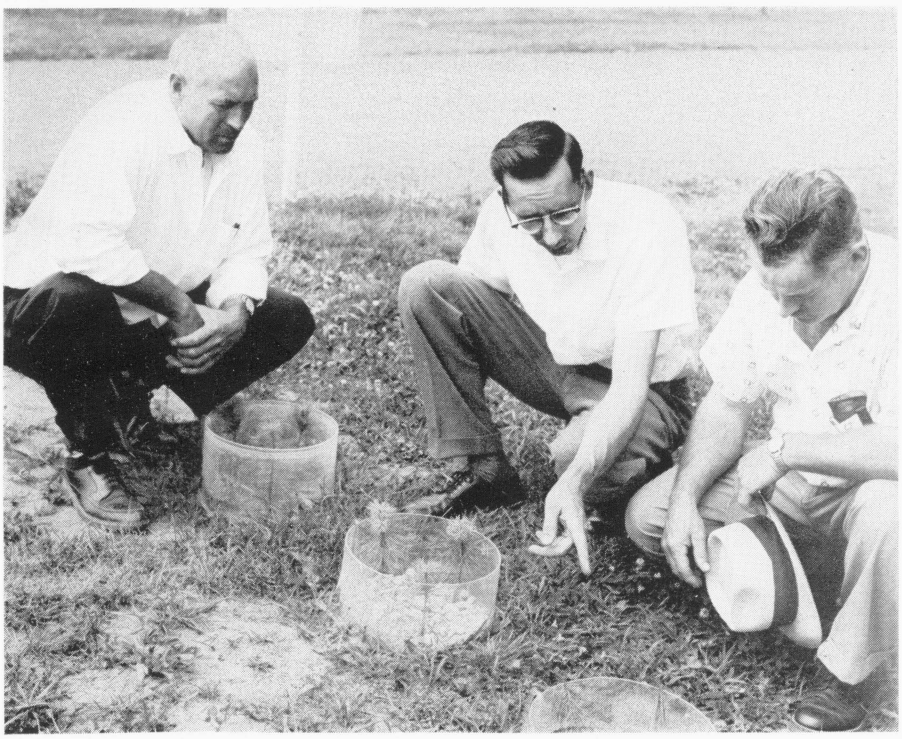
ENTOMOLOGY . . . Japanese beetle, corn borer, spittlebugs, moths, aphids . . . all are potential destroyers and profit reducers of all phases of Ohio agriculture. And all of them are enemies of our entomologists who are constantly on call to devise treatments for the pests. Along with the old and established insects some new ones continually come along, like the face fly of a season ago.

Spraying, dusting and other methods help kill off these pests and members of the department constantly come up with recommendations for vegetable growers and others needing the information.

In the two photographs above are graphic examples of the value of the research done by entomologists. The cabbage on the right was sprayed with endrin to control the imported cabbage worm and the cabbage looper while the unsprayed one on the left shows the intensive damage caused by these insects feeding on the leaves.

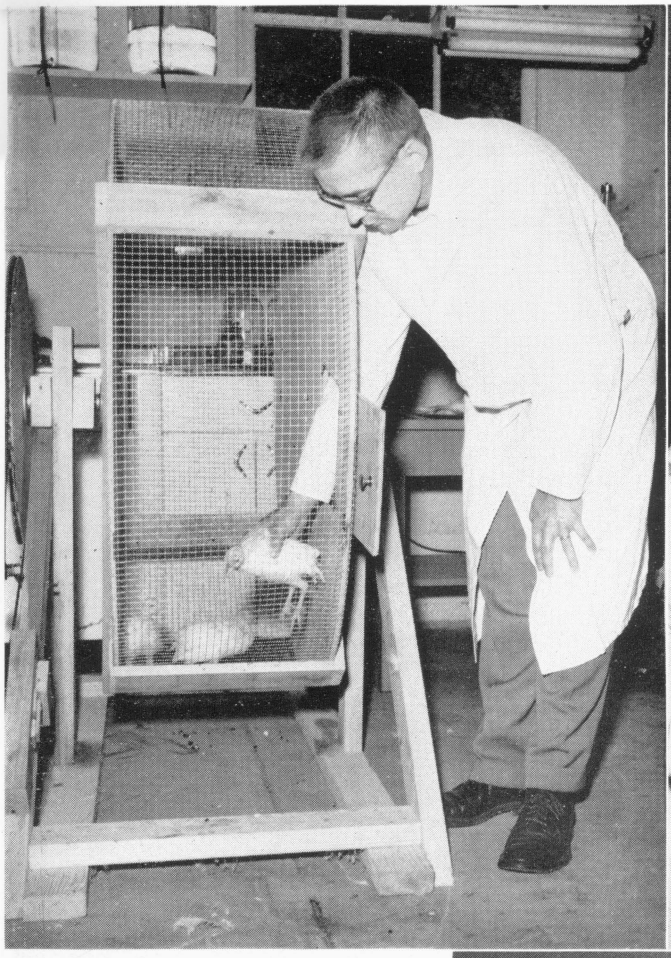
In the photograph above the effect of nitrogen on corn borer development is being studied. Reducing borer damage means a larger margin of profit for Ohio farmers and better living for urban residents.

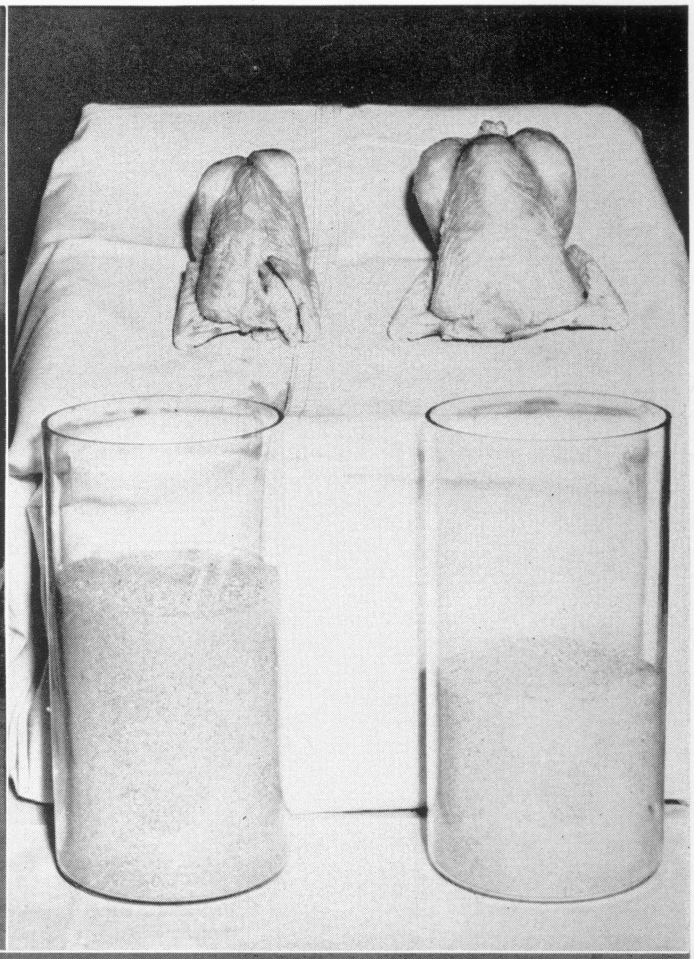
FORESTRY . . . Ohio's forest acres contribute a sizable amount to the state's economy. With that in mind, research in this department of the Station is aimed at many factors ranging from timber management to strip-mine reclamation. The photograph at upper left shows a pollination procedure in an attempt to improve the quality of pines. Right, above, shows an interesting test conducted to improve Christmas tree safety. The tree at the left was sprayed with a latex solution and retained its needles while the untreated tree at right lost most of its needles with only slight jarring. At left, below, strip-mine conditions are being checked in an area adjacent to the Wood Utilization Laboratory. Soil situations similar to those in the strip mine reclamation projects are duplicated and tree growth compared on different treatments.

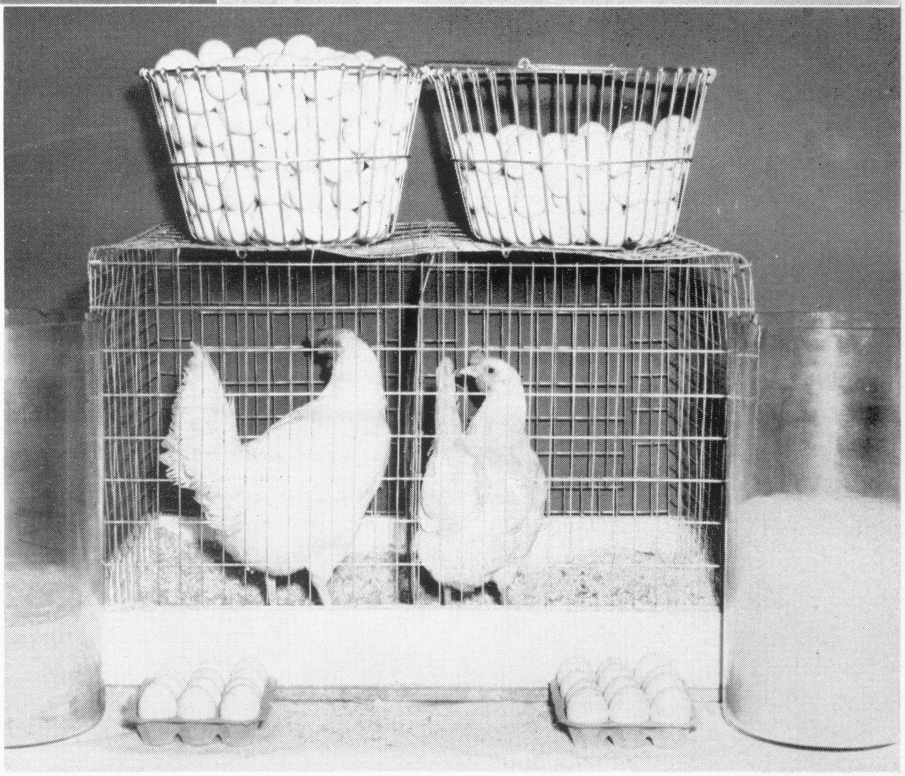


HOME ECONOMICS . . . This department is attempting through many research projects to make things easier for Ohio homemakers. Studies on appliances have made it easier for purchasers of equipment to make decisions—the same type of research has been extended into clothing purchases. The illustration at the right is a phase of a project to determine the energy requirements of doing the household chores. The woman is wearing a respirator while she dusts so that the exertion can be carefully checked. In the photograph at the bottom of the page a project leader in home economics is shown interviewing one of 103 farm families who participated in a study of family financial situations related to economic progress since marriage. For another study on laundering costs, 24 families kept detailed records for a 12-week period. It is through such cooperation that factors conducive to effective financial management are being studied realistically.

HORTICULTURE . . . Introducing three new apple varieties in recent years has been a major accomplishment of this department but it is also interested in all phases of fruit and vegetable production and processing. Research is divided into many segments ranging from variety evaluation to cultural practices. The photograph at the top of the page shows a new method of trellising grapes. This method together with balanced pruning is helpful in adjusting the crop load to vine vigor and improving quality. In the illustration at lower left a staff member is gathering leaf samples for spectrographic analysis to determine the results of fertilization practices. At the right is shown some of the newer work directed at improving that important holiday flower, the poinsettia.

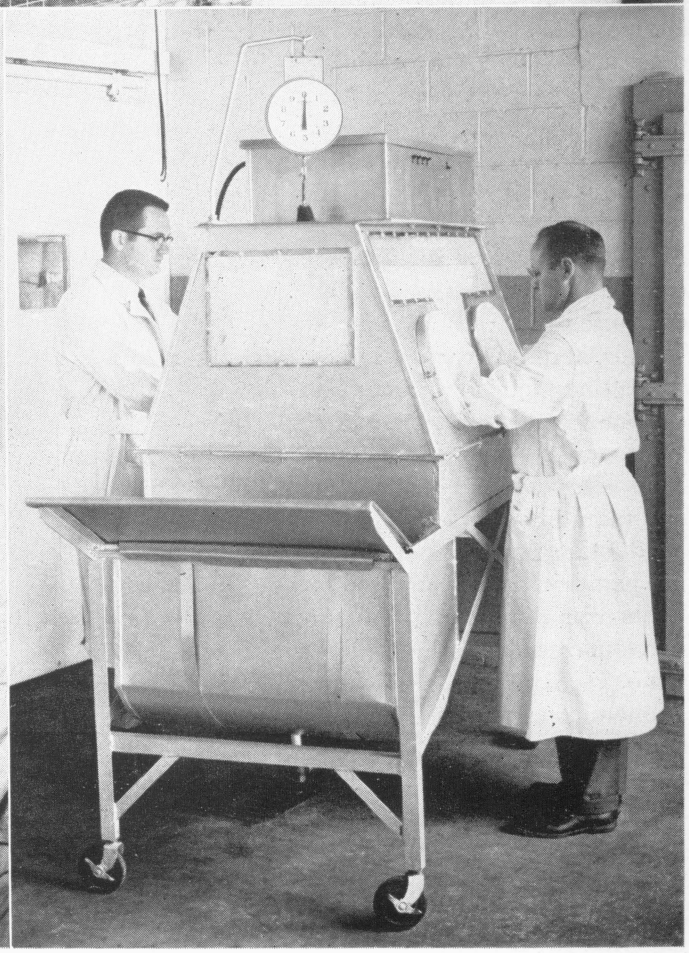






POULTRY SCIENCE . . . Your chicken or turkey is a more economical meal if flocks are kept free from disease and nutritional practices produce a tender, full-bodied bird. Those items are among the goals of our poultry scientists. In the photograph at the top, on the left, turkey poults are subjected to stress tests to determine the physiological effects on the birds. On the right above is an example of the effect of research on producing a heavier, better proportioned chicken more quickly and with less feed cost. Much the same result is shown at right with the hen at left laying more eggs with considerably less feed.

VETERINARY SCIENCE . . . In the past, research in this area has accomplished such things as minimizing the losses from hog cholera . . . presently it is continuing the fight on a newer problem, shipping fever. There can be no letup in attempting to improve animal health. In the photo at right a turkey poult is being checked to determine its reaction to respiratory diseases. Below at left, Station veterinarians are completing the operation to produce a 'window' in the side of a steer so that the fistula will provide a means of studying what happens to the rations the animal receives. At right, equipment of this type is used to insure pathogen-free animals for disease research.



Research Projects . . .

Staff members worked on these projects during the past year . . .

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

Marketing Ohio milk and cream.
Significant trends in the milk industry and their effect on milk markets.
Elasticity of demand for farm products important to Ohio agriculture.
Analysis of effects of changes in technology on farm production costs and returns, and on efficiency in the allocation of resources.
Milk production costs and types management that will reduce costs.
Pricing of milk and its products; Marketing surplus milk in Ohio fluid milk markets.
Respiration and associated factors as indices in the determination of the period of marketability (shelf-life) of fresh (unprocessed) fruits and vegetables.
Economics of different systems of farm management on the Old Lake Bed soils of Northwestern Ohio.
Problems of rural areas resulting from populations changes in Ohio.
Marketing of greenhouse vegetables in Ohio, with emphasis on competition from winter and spring production areas.
Trends in production prices and in the methods of marketing Ohio fruits and vegetables.
Economic and social aspects of part-time farming in Ohio.
Methods, costs and efficiencies in grading, packaging and marketing apples.
Production and marketing of cut flowers and flowering plants in small pots.
Economics of pasture production.
Economic study of the commercial beef enterprise in Ohio.
Economics of various methods of harvesting, storing and feeding forage.
Market outlets and marketing procedures for wool and lambs in Ohio.
Market outlets and marketing procedures for Ohio wool.
Analysis of market outlets and marketing procedures for Ohio lambs.
Wheat price and income policy.
Shipping fever complex in cattle.
Ohio grade-price relationships for potatoes with special reference to the nearby producer (deficit production area).
Economics of the sheep enterprise in Ohio.
Markets and marketing of Ohio-grown Christmas trees.
Analysis of changes in patterns of livestock marketing in Ohio.
Production and marketing of nursery stock in metal containers.
Marketing of nursery stock in metal containers.
Factors affecting operating costs, service charges and margins of country elevators in Ohio.
Improving the financial management of agricultural marketing agencies.
Pricing and trading practices for grain in Ohio.
Communication process and its relationship to the adoption of farm and home practices.
Economic problems in adjustment to changing prices on typical farms in West Central Ohio.
Analysis of the impact of past and present agricultural policies on the quantities of agricultural produce marketed, channels used in marketing, and market structure in Ohio.
Analysis of the economic factors influencing Ohio's future livestock marketing and processing.
Measurement of the amount of shrink in different classes and species of Ohio livestock under various conditions, distances and handling procedures.
Marketing fertilizers in Ohio.
Analysis of fresh fruit and vegetable prices on the Ohio wholesale markets.
Economics of producing the major farm crops in Ohio.
Projection and analysis of long-time economic trends in agriculture and related industry.
Evaluation of direct sale to consumers as a means of marketing fruits and vegetables in Ohio.
Marketing practices and price formation in Ohio farm woodland forest product sales.
Transfer of farm real estate by use of land contracts.
Urbanization, farm land consolidation and opportunities for farming, full-time and part-time in Ohio.
Analysis of new dairy production systems and the development of improved farm organizations for Ohio dairy farms.

Analysis and comparison of the economics of forage management systems.
Study and classification of the managerial resource in farming.
Adjustments in financing and management needed for betterment of agricultural business firms.
Adjustments in livestock marketing in the North Central States to changing patterns of production and consumption.
Changing market structure and organization of Ohio's dairy industry.
Economic analysis of bulk feed and grain bank operations at country elevators in Ohio.
Adjustments in production of hogs and beef to economic and technological changes.
Effect and evaluation of the conservation reserve program on Ohio agriculture.
Timber products marketing in a 15 county study area.
Analysis of market milk distribution systems.
Effect of transportation and service developments on the grain, feed and farm supply agencies in Ohio.
Effect of packaging meat and fruits and vegetables on efficiency of retail merchandising.
Income of Ohio farmers by counties.
Desirable adjustments in Ohio's crop and livestock pattern, both long time and for the year ahead.
Changes in Ohio farm land values and their causes, and the use of mortgage credit.
Problems and opportunities which programs of rural development and rural industrialization bring to agricultural counties in Ohio.
Rural zoning and associated planning and regulation of rural land uses.
Distress situations in the use and management of credit by Ohio farmers.
Economic development of resources and incomes in low-income farm areas.
Factors affecting membership relations in milk marketing organizations of Ohio.
Developing a formula for pricing live graded hogs that can be utilized under changing economic conditions.
Social and social-psychological causes of and adjustment to heart disease.
Analysis of the distribution of dairy products through retail food stores.
Factors motivating farmers in selecting their livestock markets.
Impact of demonstrations on farmer attitudes toward fertilizer.
Factors affecting the location of seed conditioning facilities in Ohio.
Development of improved methods of putting up and marketing fleece state wools.
Labor efficiency in supermarket merchandising.
Brokerage of dairy products in the Cleveland market.

AGRICULTURAL ENGINEERING

Tillage practice in relation to soil tilth and crop response.
Drainage investigations for agricultural lands.
Harvesting and storing of corn and small grains.
Development of equipment and evaluation processes for agricultural aircraft.
Basis for agricultural aircraft equipment design.
Corn production; intercropping.
Heat exchangers and filter systems for use with heat pumps in broiler houses.
Improving methods and equipment for harvesting soybeans.
Effect of row spacing, population, and plant distribution on corn yield and soil moisture—soil temperature relations.
New threshing principles.
Feed lot management and performance of fattening steers and bulls under varying housing conditions.
Measurement of stresses in an experimental machinery shed.
Evaluation of corn harvest methods.
Design characteristics of tractors involved in fatal farm accidents.
Energy requirements and work methods for farming.
Feed lot and farm roadway paving methods.
Quality and yield of hay resulting from various harvesting methods.
Quality and effect of treatment of water from farm ponds.
Effect of new harvesting and curing procedures on the quality of tobacco.
Development of improved subsurface drainage.
Design requirements of small diameter subsurface drain tubes as an approach to low cost drainage systems.

AGRONOMY

Factors affecting growth and mineral absorption by plants.
Mineral absorption by plants in relation to the soil moisture supply.
Factors affecting the absorption by soybeans of native soil manganese and applied manganese.
Use of foliar applied manganese in correlating manganese deficiency in agronomic crops.

Chemical estimation of plant available soil manganese.
Breeding field corn for Ohio.
Oat breeding and testing.
Production, management and utilization.
Pasture species for beef animals.
Effect of length of harvest period and rest period on yield and survival of forage plants.
Soil structure; its importance to crop production, and the improvement which may be affected by soil management systems.
Tillage practice in relation to soil tilth and crop response.
Establishment and maintenance of forage crops.
Development and evaluation of improved varieties of soybeans for farm and industrial utilization.
Factors affecting the release of exchangeable and non-exchangeable potassium from soils.
Relation of soil temperature to growth and mineral absorption by plants.
Drainage investigations for agricultural lands.
Hydrologic aspects of drain depth and spacing as related to soil physical properties, climate, crop response, and crop rotations.
Effectiveness of surface and sub-surface drainage for slowly permeable soils.
Soil characteristics which effect subsurface drainage.
Eradication or control of weeds and other undesirable plants.
Chemical and cultural control of weeds in field crops.
Weed control in turf.
Chemical and physical properties of soil organic matter.
Use of the spectrograph for analysis of soil extracts and plant materials.
Development of X-ray diffraction techniques for soils, clay fractions, and plant materials.
Evaluation of new and standard strains of forage crops.
Intercropping in corn.
Distribution study of plant parasitic fungi and nematodes.
Soil and plant survey at the Muck Crop Substation to determine the cause for irregularities in plant growth.
Quality evaluation of soft winter wheats.
Development of new cropping systems.
Development of cropping systems for soils in which chronic plasticity imposes restrictions on crop production.
Comparison of upright and prostrate broadleaf birdsfoot trefoil under grazing with two management systems and two species of grazing animals.
Improving methods and equipment for harvesting soybeans.
Ionic interactions in soils and in systems of plant roots in relation to nutrient uptake.
Efficiency of fall and spring applied nitrogen for corn.
Winter injury to crop plants from the indirect effects of low temperature.
Tabulation and summarization of Ohio weather data.
Mineral element nutrition of corn.
Comparison of once-a-day and twice-a-day chopping when soiling meadow crops for dairy cows.
Relating crop yields with the nutrient element status of Ohio soils. (Soil test correlation investigation.)
Nitrogen fertilization and green manuring studies with continuous corn.
Factors affecting corn ear development with increased plant populations.
Effect of row spacing, population, and plant distribution on corn yield and soil moisture– soil temperature relations.
Comparison of grazing and soiling for summer feeding dairy cows.
Fundamental research in corn breeding methods leading to isolation of superior germ plasm.
Wheat breeding and evaluation.
Development of improved methods of breeding corn.
Wheat testing and improvement.
Barley testing and improvement.
Ohio soil survey.
Composition of the parent material of the glacial soils of Ohio, especially as regards the lime carbonate and clay content.
Mineral composition of Ohio soils.
Physical and chemical characteristics of important Ohio soils.
Culture and rotation experiments with soybeans.
Conservation and improvement of muck soils.
Soil fertility and fertilizer practices.
Nitrogen fertilizer studies on corn, small grains and sugar beets.
Reclamation and use of strip-mined land in Ohio: Spoil properties and the establishment of forage species.
Cultural practices for sugar beets.
Turf culture and pest control.
Evaluating the quality of new, improved disease and insect resistant soft wheat varieties for cakes, cookies and other furnished products.
Preliminary study of the mechanical harvesting and rapid curing of tobacco.
Culture of burley tobacco.
Burley tobacco variety tests.
Fertilization of tobacco.
Nitrogen fertilization and irrigation of tobacco.
Continuous tobacco culture.
Evaluation of new and standard strains of forage crops.

Seed corn storage studies.
Detailed characterization of soil and vegetation on selected sites to serve as basis for future evaluations of effects of radioactive contamination.
Factors affecting yields and uptake of phosphorus from insoluble (rock phosphate), slightly soluble (super phosphate), and highly soluble (ammonium phosphate) sources.
Transformation of nitrogen and carbon during decomposition of soil organic matter and incorporated green manures.
Quality and yield of hay resulting from various harvesting methods.
Extractable aluminum in Ohio soils as a factor in alteration of the actual need of lime by field soils.
Mechanical harvest and curing of burley tobacco.
Soils moisture movement in unsaturated soils: 1. Thermokinetics of soil moisture.
Relating the yield response of winter wheat and corn to supplemental urea nitrogen applications on soils with varying soil nitrogen reserves.

ANIMAL SCIENCE

Improvement of the method for determining crude fiber and nitrogen free extract (N.F.E.) in feeds.
Types of sheep and systems of breeding for market lamb production.
Relationship between various feeds or nutrients and the protein requirements of fattening cattle.
Digestion studies with beef cattle.
Factors affecting the utilization of feeds by ruminants.
Influence of ladino clover and birdsfoot trefoil pasture on reproductive efficiency of sheep.
Pastures and their supplementation for pigs.
Nutritional requirements of early weaned pigs.
Biochemical and physiological basis for quality of meat and biochemical and bacteriological studies fundamental to the processing of fresh meat.
Influence of sex hormones upon growth rate, fattening and carcass quality of feeder calves.
Relationships between body conformation, rate of gain, and carcass value as measured in a breeding herd of Hereford cattle.
In-Vitro digestibility of cellulose from various sources and the effect of lignification thereon.
Nutritive value of cured or dehydrated legumes in dry lot breeding and gestation diet for swine.
Comparison of upright and prostrate broadleaf birdsfoot trefoil under grazing with two management systems and two species of grazing animals.
Measurement of, and ways of affecting, sex-influenced performance of growing-finishing swine.
Adaptability and productive value of Columbia and Targhee sheep for farm flock use in the North Central Region.
Development and use of the **In-Vitro** rumen fermentation and the effective nutritive value index in evaluating Ohio forages.
Adaptability, place and use of Columbia sheep in Ohio.
Meadows and pastures for hay and forage on the sheep farm.
Infant mortality among lambs.
Feed lot management and performance of fattening steers and heifers under varying housing conditions.
Creep diets and management practices related to the creep feeding of pigs.
Effectiveness of Erysipelas Bacterin in the prevention of erysipelas in swine.
Reproductive performance in swine.
Swine artificial insemination field trial.
Effect of Estradiol-progesterone implants on the performance of growing-fattening lambs on different types of feed.
Creep feeding systems and rations for the production of market lambs from three-breed-cross ewes.
Epizootiological studies on the porcine enterovirus infections.
Methods of feeding protein and mineral supplements to growing hogs on pasture and in dry lot.
Carcass evaluation of meat-type hogs.
Effect of frequency of feeding upon growth rate of beef calves.
Tabulation and analysis of data from Swine Evaluation Station and Experiment Station projects.
Effectiveness of Hygromicin B in the control of round-worm, nodular worm and whipworm in gestating, lactating and suckling swine.
Copper utilization.
Use of feed additives and adjuvants in the production of market lambs and their effects on the efficiency and physiology of reproduction of ewe lambs.
Comparison of Hereford and Charolaise breeds and their reciprocal crosses under three systems of management.
Control of pink eye in cattle.
Feeding and management of gilts, sows, and growing-finishing swine.
Feeding and management of gilts and pigs—1959-60.
Management factors affecting performance of swine.
Processing of fresh meat.
Purified rations for ruminant animals.
Factors affecting the utilization of feed by ruminants. II. Studies on factor(s) required by rumen microorganisms for cellulose digestion in the artificial rumen.

Methods of reducing the rate of urea hydrolysis by rumen microorganisms through the use of a protective coating on the urea particles.
Value of fats from the sperm whale in the nutrition of ruminant and non-ruminant animals.
Digestibility of soybean hulls and other by-product mill feeds using the artificial rumen technique.
Growth factors for rumen microorganisms **in vitro** and **in vivo** and the utilization of lactic acid and non-protein nitrogen in steepwater by ruminants.
Antibacterial agents in rations for swine on pasture and in dry lot.
Mineral and Vitamin D requirements and factors affecting feed consumption in pigs three to eight weeks of age.
Carbohydrate metabolism in rumen micro-organisms.
A preliminary study of the effects of various anabolic agents on growth and carcass characteristics of swine.

BOTANY AND PLANT PATHOLOGY

Antibiosis in relation to plant disease.
Control of fruit diseases.
Evaluation of fungicides and the timing of the fungicide applications for the control of apple scab and other fungus diseases of apple.
Control of fungus diseases of stone and small fruit plants.
Control of bacterial diseases of fruit plants.
Control of vegetable diseases.
Comparison of new fungicidal, chemotherapeutic, and nutritional formulations for the control of vegetable diseases.
Development of new methods for the application of fungicidal formulations to vegetables with particular reference to the use of low-gallonage sprays.
Improvement of vegetable stands by the use of seed treatment.
Development of disease resistant strains of cucumbers.
Pathogenic variability and the inheritance of disease resistance in tomato.
Cytogenetics and embryology of the domestic tomato, the wild species of tomato, and their hybrid derivatives in relation to disease resistance, hybrid sterility and self incompatability.
Development and evaluation of improved varieties of soybeans for farm and industrial utilization.
Diseases of carnations (Dianthus caryophyllus), their control and related cultural practices.
Cereal disease investigations.
Effect of crop rotations in the incidence of diseases caused by soil-borne pathogens and associated changes in soil fungus populations.
Chemical control of cereal crop diseases.
Evaluation of the collection of domestic and wild species of tomato, and the maintenance of the desirable accessions and valuable breeding stocks.
Biology of the tomato early blight organisms with reference to the existence of races and resistance.
Forage crop and soybean disease investigations.
Stone fruit virus diseases and their control.
Fundamental study of the tobacco mosaic virus and other viruses of greenhouse tomatoes.
Oak wilt disease.
Pathological aspects of the oak wilt disease.
Control of soil inhabiting nematodes, fungi, bacteria and insects affecting vegetable crops.
Control of plant parasitic nematodes.
Biological control of diseases on the aerial parts of plants.
Control of soil-borne diseases of glasshouse vegetable crops by nutrient solution culture.
Turf culture and pest control.
Bioclimatic and soils investigations in forest environments.
Investigations of fungi and actinomycetes in the rhizospheres of field crops.

DAIRY SCIENCE

Relationship between the serum protein-bound iodine and plasma cholesterol in the bovine and their possible application to dairy production.
Crops and practices for a dairy enterprise.
Fundamental factors affecting roughage utilization, early establishment of rumen function, and health of dairy calves.
Cellular antigens in the blood of cattle.
Effectiveness of reciprocal crossing in blending and fixing the desirable dairy characteristics of various families of Holstein cattle.
Use of cattle twins and triplets to study the relative influence of inheritance and management on efficiency of feed utilization and production.
Chemistry and physiology of bloat.
Effect of breeding and management practices on dairy herd performance.
Evaluation of criteria for breeding, selecting and culling of dairy animals.
Influence of inheritance on the composition of milk.
Factors that affect utilization of nitrogen from protein and non-protein nitrogen sources in dairy cattle.
Comparison of once-a-day and twice-a-day chopping when soiling meadow crops for dairy cows.
Processing, preservation, utilization and chemical analysis of meadow crops and meadow crop silages.

Application of the high roughage system of raising dairy calves for beef feeders and a comparison with beef bred steers in the feed lot and on the basis of carcass quality.
Developing a herd of high milk producing Jerseys through the appropriate selection of sires.
Inheritance of taillessness in calves and its prevalence in herds using artificial breeding service.
Color inheritance in cattle as it affects parentage exclusion and the detection of cattle carrying undesirable recessive genes.
Calcium, phosphorus, Vitamin D and parathyroid relationships in mature dairy cattle.
Cytological studies of cattle.
Effect of liberal concentrate feeding at calving time, on clinical and subclinical ketosis.
Reproductive performance in swine.
Improvement in techniques in artificial insemination.
Factors affecting ovulation in cattle.
Relative value of certain melanin fractions to differentiate between genotypically different black phenotypes of cattle hair when used both separately and combined into a differentiating index.
Studies on anemia in dairy calves.
Flavor of market milk in relation to the variations in minor organic constituents.
Chemical and bacteriological factors affecting the market quality of cultured dairy products.
Investigation of methods to improve and standardize the spreading quality of butter and to determine the physical-chemical properties of butter which are involved.

DAIRY TECHNOLOGY

Flavor of market milk in relation to the variations in minor organic constituents.
Chemical and bacteriological factors affecting the market quality of cultured dairy products.
An investigation of methods to improve and standardize the spreading quality of butter and to determine the physical-chemical properties of butter which are involved.

ENTOMOLOGY

Evaluating insect resistance in onion varieties, strains and hybrids.
Biology and control of insect pests of stone fruits.
Factors influencing the incidence of apple insects and mites in different orchards and the possible utilization of these factors in control programs.
Evaluating insect resistance in varieties and strains of potato.
Insect phases of greenhouse vegetable crop production with emphasis on insect pollinators as well as destructive pests.
Establishment and maintenance of forage crop stands.
Biology, ecology and control of forage crop insects, with special emphasis on clover leaf weevils, the potato leafhopper and the meadow spittlebug.
Possible vectors of the oak wilt disease organism.
Pesticidal residues in soils following pest control practices.
Insect phases of the corn research program with special emphasis on the European corn borer and minor emphasis on corn rootworms, corn earworm, corn leaf aphids, and corn flea beetles.
Effect of time of planting, weather and character of plant growth on corn borer populations.
Control of soil-inhibiting nematodes, fungi, bacteria and insects affecting vegetable crops.
Pesticide residues on animal feeds and human foods.
Ecological study of the Red-winged Blackbird as it is related to the damage of crops.
Insects infesting grain, grain products and related commodities.
Biological and chemical control of the Japanese beetle.
Economic aspects affecting honey production and insect pollination of agricultural crops.
Biology and control of insects attacking ornamental plants.
Biology and control of vegetable crop insects.
Biology, ecology and control of insects attacking apples and pears.
Turf culture and pest control.
Biology, ecology and control of the insect pests attacking livestock.

FORESTRY

Market for and marketing of Ohio grown Christmas trees.
Marketing practices and price formation in Ohio farm woodland forest product sales.
Improvement through selection and breeding of tree species for planting in Ohio, with emphasis on northern red oak.
Sustained yield management of experimental forests.
Hardiness, adaptability and identification of species, varieties and clons of some woody ornamental plants.
Improvement of Ohio nut trees for wood and timber production.
Timber type Asiatic Chestnuts.

Reclamation and use of strip-mined land in Ohio.
Use of strip-mined land for forest crops.
Growth responses of forest tree seedlings in relation to differences in spoil materials.
Ecological aspects of the oak wilt disease.
Management of forest and Christmas tree plantations in Ohio.
Use of lime and fertilizers in the sugarbush.
Selection and breeding of forest trees.
Genetic improvement of maples for sugar yield.
Improvement of wood quality vigor and pest resistance in forest trees. Established of a seed-source study of sugar maple.
Properties and utilization of forest tree species abundant in Ohio.
Relationship of durability to extractive content of several Ohio species.
Relationships between moisture content and stress level on the initiation of set in wood stresses in tension parallel to the grain.
Modification of wood and wood products.
Double diffusion method of treating fence posts.
Christmas tree production.
Forest physiology.
Inorganic nutrition of forest trees.
Influence of environmental factors on forest trees.
Chemical and physical properties of wood "fibres".
Selected factors affecting the character and quantity of sugar sand formed in maple sirup.

HOME ECONOMICS

Physiological responses of women at work in the home: relationship to use and care of stairways with special reference to surface materials.
Analysis of some economic and personal factors which have influenced the home and family life of a selected group of young farm families.
Effects of diet upon the activities of digestive and absorptive enzymes.
Effects of diet on the gastro-intestinal tract.
Criteria that influence the selection of garments for school wear by ninth grade girls.
Income and money disbursements of beginning farm families in terms of inter-farm-household operation, management, family satisfactions and future plans.
Effects of certain factors in the roasting of beef in quantity.
Interrelationships of various dietary factors and amino acid metabolism.
Farm family financial situation and procedures in relation to economic progress since marriage.
Food patterns of Ohio preschool children in relation to those of their families.
Relation of employment outside the home to selected home management practices of a group of Ohio rural homemakers.
Energy requirements for household activities.
Techniques, equipment and agents for use in home care of venetian blinds.
Water conditioning as it is related to management practices and costs in homes.
Management aspects of family laundering at home and with commercial services.
Physiological responses of women at work in the home; relationship to care of hard surface floors.

HORTICULTURE

Causes of abscission of flowers and young fruits following applications of synthetic hormones and the relation of naturally occurring hormones to such abscission.
Response of the peach to different cultural practices, and rates of nitrogen fertilization as indicated by growth, yield, quality of fruit and mineral composition of the foliage.
Responses of the red raspberry to different soil management practices, training systems, and rates of nitrogen fertilization as indicated by growth, yield and mineral content of the leaf.
Development of methods for evaluating quality of fresh and processed fruits and vegetables.
Grape varieties, environmental factors, and culture practices in relation to productivity and quality of fresh grapes and processed grape juice.
Modified atmosphere holding and storage of vegetables.
Methods of handling the peach in relation to physiological changes and market acceptance.
Environmental factors affecting the growth of greenhouse roses, with special emphasis on air and leaf temperature, air movement, carbon dioxide, relative humidity, and nitrogen nutrition.
Respiration and associated factors as indices in the determination of the period of marketability (shelf-life) of fresh (unprocessed) fruits and vegetables.
Nitrogen and mineral nutrition of fruit trees.
Eradication or control of weeds and undesirable plants. Chemical and cultural weed control studies with horticultural crops.
Interrelation of frequency of irrigation and rate of application of nitrogen fertilizer on the yield and quality of potatoes grown on sandy loam.
Production and marketing of cut flowers and flowering plants in small pots.

Influence of variety, fertilizers and date of planting on quality of potatoes manufactured into potato chips.

Relation of processing technique and chemical composition to the quality of potato chips.

Survey of soil and crop potentialities and causes of variability on the State Muck Crops Research Farm.

Production and marketing of nursery stock in metal containers.

Comparison of fruits and vegetables processed by radiation sterilization with the same fruits and vegetables processed by canning and freezing.

Apple scald control by means of oxidizing and absorbing agents at the surface of the skin.

Manufacture and quality evaluation of strained (pureed) foods.

Development of apple-fruit juice blends to further increase the utilization of apples.

Use of maleic hydrazide in the inhibition of sprouting in potatoes and onions during storage.

Evaluation of vegetable varieties for processing (canning and freezing).

Effect of magnesium and of trace element applications upon yield, quality and foliar composition of onions and celery grown on muck.

Response of the black raspberry to different training systems and severities of pruning as indicated by growth, yield and quality of berries produced.

Development and evaluation of frozen fruit pies from Ohio fruits.

Factors affecting the quality, marketing and consumer acceptance of fermented foods with and without added flavor and spice ingredients.

Interactions between light intensity, day temperature and night temperature on development, yield, and quality in greenhouse tomatoes.

Relationship between soil moisture regime and pruning on growth and development, yield, and fruit quality of greenhouse tomatoes.

Radiochemical determinations of pesticides and food additives before, during and after processing.

Phenological and weather studies in relation to orcharding.

Propagation of ornamental plants.

Effect of growth promoting substances, height of heading, and deshooting upon the development of the framework and growth of young apple trees.

Apple breeding for the purpose of producing late-blooming, late-keeping varieties possessing qualities desirable for commercial use.

Tests of new and uncommon pear varieties with particular reference to the character, yield and dessert of the fruit.

Growth, yield and quality of apple varieties as affected by size controlling rootstocks and hardy interstocks of domestic and foreign origin.

Chemical sprays as a means of inducing flower and fruit abscission in the apple and peach in order to replace hand thinning or to change the year of bearing.

Use of growth promoting substances (hormones) in relation to the pre-harvest abscission of fruit.

Breeding greenhouse tomatoes.

Evaluation of promising selections and varieties of certain stone and small fruits for Ohio: peaches, plums, sour cherries, and apricots; strawberries, blueberries and bramble fruits.

Soil and cultural treatments for blueberries.

Flower bud initiation and flower color of the hydrangea.

Initiation and development of flower buds in greenhouse azaleas.

Fertilizers for early vegetable crops on sandy soil.

Relation of nitrogen applications to yield and chemical composition of the leaves of cucumbers.

Exploratory- Soil fertility levels for various vegetable crops.

Hardiness, adaptability and identification of species, varieties and clons of some woody ornamental plants.

Vegetable variety testing.

Testing varieties and strains of nut trees.

Development of improved varieties and strains of tomatoes for fresh market and processing.

Cultural experiments on tomatoes for canning.

Spacing and methods of applying fertilizer studies with determinate, intermediate and indeterminate-type tomatoes.

Cultural experiments on tomatoes for processing.

Experimental analysis of climatic and edaphic factors contributing to yield and quality differences to tomatoes grown in the processing areas of Ohio.

Some environmental factors influencing the number of flowers on Easter lilies.

Effect of insecticides and fungicides on the composition, quality and shelf life of processed vegetables and fruit.

Reclamation and use of strip-mined land in Ohio.

Use of strip mine spoil banks for the growing of fruit crops.

Growth and production of tomatoes in the greenhouse as influenced bv various levels of nitrogen, phosphorus and potassium, and of certain mulch materials applied to the soil and the effect of the latter on some physical and biological characteristics of the soil.

Variety studies with some greenhouse ornamental plants.

Apple variety trials, including testing of red strains of standard varieties.

Productivity of nursery soils under various cropping systems.

Relation of fertilizers, date of planting, and other cultural practices to the yield and quality of potatoes grown in Wooster silt loam.

Causes of tree decline in varieties of European Plum (prunus domestica) with special reference to stocks, incompatabilities and low temperature injury.

Content and fractions of mineral elements in aerial and root portions of several woody ornamental plants.

Growth and flowering of the greenhouse chrysanthemum.

Effect of short exposures to various temperatures during the small plant stage on the subsequent growth and flowering of snapdragons.

Effect of varying night temperatures applied to tomato plants following cotyledon expansion upon subsequent flowering and fruiting.

Effect of different amounts of water upon fruit yield and quality as well as amount of blossom and rot and blotchy ripening in two tomato varieties.

Flowering of the greenhouse carnation as affected by environmental factors with special emphasis on light and temperature.

Effect of daylength, temperature, date of propagation and pinching on the growth and flowering of poinsettias (Euphorbia pulcherrima).

Influence of root-medium oxygen on the growth and flowering of snapdragons (Antirrhinum majus).

Effect of applications of boron, manganese and molybdenum upon the yield, quality and foliar content of essential nutrients in two varieties of early cauliflower.

Mineral element content of aerial and root portions of several florist crops.

Effect of application of trace minerals and mixtures of carbon with trace minerals on foliar analysis and fruiting of field and greenhouse tomatoes and grapes growing in soils which have previously produced plants containing subnormal amounts of certain elements.

Use of Uramite as a source of nitrogen fertilizer for woody ornamental plants.

Specific washing methods and techniques to remove pests and their residues, extraneous foreign matter and other contaminants from sweet corn and tomatoes.

Specific quality control instruments for evaluating and controlling the consistency of canned cream style corn made from known qualities of raw yellow sweet corn.

Selected factors affecting the character and quantity of sugar sand formed in maple sirup.

Preservation of food for room temperature storage by packaging in flexible films.

POULTRY SCIENCE

Nutritional and physiological factors affecting the production, hatchability and quality of eggs.

Effect of nutrient density and nutrient interrelationships on the reproductive performance of chickens.

Methods of maintaining quality in poultry products.

Shelf-life of fresh slaughtered unfrozen poultry.

Relation of Ohio farm prices of poultry to the methods used in marketing and the prices quoted in terminal markets.

Genetics of endocrine function in chickens and turkeys.

Selection and mating methods for poultry.

Physiology of reproduction in the male turkey.

Evaluation of selection for single physical traits in the turkey by correlated responses and diallel crossing.

Endocrine control as a factor in the reproduction of the female turkey.

Relation of the volume of poultry products sold to marketing costs.

Nutritive requirements of turkey breeders.

Unidentified reproductive and progeny growth factors in turkey nutrition.

Effect of physical and chemical treatment of feedstuffs on growth and nutrient utilization by the chick.

Physiology of reproduction in the turkey female.

Physiology of stress in turkeys and chickens.

Utilization of inedible poultry by-products.

Poultry manure and litter.

Increasing the market for poultry and poultry products by developing new food uses.

Comparisons of Ohio rations for layers.

Comparison of feeding systems for turkeys on range and in confinement.

Nutrient requirements of turkeys.

Energy metabolism in growing turkeys.

Effect of range or confinement rearing and restricted nutrient intake during the growing period on subsequent reproductive performance of chickens.

Effect of compost (built-up) litter for rearing turkeys.

Development of high efficiency poultry rations.

Development of high efficiency broiler rations.

Evaluation of nitrofurans for productive performance in the turkey.

VETERINARY SCIENCE

Development of passive immunity in young pigs nursing hog cholera vaccinated gilts.
Fundamental factors affecting roughage utilization, early establishment of rumen function, and health of dairy calves.
Mastitis of cattle. Factors responsible for variation in resistance to mastitis.
Chemistry and physiology of bloat.
Causes and prevention of hemorrhagic disease in chickens.
Clinical and pathological aspects.
Shipping fever comlex in cattle.
Physiology of reproductive in the male turkey.
Photoperiodism as a factor in the reproduction of the turkey.
Chronic respiratory disease in chickens and turkeys.
Respiratory disease of chickens: chronic respiratory disease and psittacosis-lymphogranuloma infections (Ornithosis).
Viruses of the Leukosis complex: studies on control and treatment.
Physiology of reproduction in the turkey female.
Application of a new, composite-milk test as a screening method for identification of Brucellosis infected dairy herds.
Physical, chemical and immunological properties of Brucella abortus antibodies.
Calfhood Brucellosis vaccination. Retention of blood agglutination titer and duration of resistance.
Leptospirosis in domestic animals.
Methods of diagnosis, the pathology produced and the methods of control and treatment in leptospirosis of swine, sheep and cattle.
Investigations of disease conditions as observed in Ohio lambs at time of slaughter.
Control of parasites in livestock and poultry.
Epizootiological studies on the porcine enterovirus infections.
Control of pink eye in cattle.
Studies on anemia in dairy calves.

OHIO AGRICULTURAL EXPERIMENT STATION

Statement of Income and Expenditures for fiscal year ending June 30, 1960

	Hatch	Section 9 B 3	Title II	Total All Other Funds	Total
Income					
Balance July 1, 1959	$---	$---	$---	$ 435,300.34	$ 435,300.34
Appropriations	779,600.00	149,650.00	15,000.00	3,173,888.56	4,118,138.56
TOTAL	$779,600.00	$149,650.00	$15,000.00	$3,609,188.90	$4,553,438.90
Expenditures					
Personal Service	$697,242.95	$122,038.47	$ 9,321.33	$1,628,997.19	$2,457,599.94
Travel	16,615.80	7,800.53	2,338.54	38,357.25	65,112.12
Transportation	29.64	---	---	6,430.96	6,460.60
Communication	174.99	7.53	---	20,029.10	20,211.62
Rents and Utilities	2,015.59	59.01	---	69,934.22	72,008.82
Printing and Reproduction	1,604.31	31.78	616.09	13,862.19	16,114.37
Other Contractual Service	3,796.91	5,428.45	---	41,493.15	50,718.51
Supplies and Materials	33,856.38	5,415.77	213.90	433,584.18	473,070.23
Equipment	24,263.43	8,868.46	10.14	150,750.44	183,892.47
Lands and Structures	---	---	---	263,882.17	263,882.17
Contributions to Retirement	---	---	---	6,181.13	6,181.13
TOTAL EXPENDITURES	$779,600.00	$149,650.00	$12,500.00	$2,673,501.98	$3,615,251.98
Funds Lapsed	---	---	---	7,067.53	7,067.53
Balance June 30, 1960	$---	$---	$ 2,500.00	$ 928,619.39	$ 931,119.39

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